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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-163139
(43)Date of publication of application : 21.06.1996

(51)Int.Cl. H04L 12/28
H04Q 3/00

(21)Application number : 06-300888
(22)Date of filing : 05.12.1994

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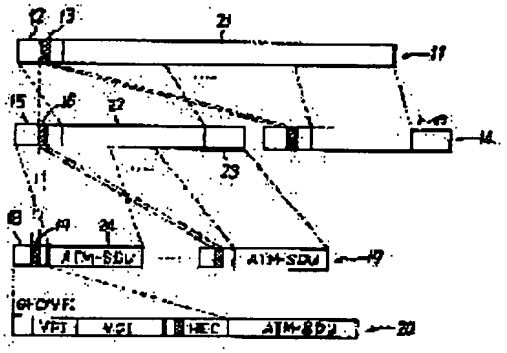
(54) PACKET COMMUNICATION METHOD

(57)Abstract:
PURPOSE: To improve a using efficiency of a network by arranging in common the data Q showing the communication quality as a part of a packet header or a trailer of every hierarchy and referring to the data Q to process the packets in every hierarchy.
CONSTITUTION: When the data are transmitted, the data string received from a higher hierarchy is divided in a TCP packet 11 and the communication quality request value Q given from the higher hierarchy is buried in a part 13 of an added TCP header 12. Then the part 13 is transformed into an IP packet 14 and the value Q common to the part 13 is buried into a part 16 of an added IP header 15. The value Q is transformed into an ATM cell 17. At the same time, the value Q common to the part 16 is buried into a part 19 of an ATM header 18. Then the packet processing is properly carried out in every hierarchy based on the value Q, and the cell and the packet are disused. Thus it is possible to prevent the useless packet transmission by the preferential processing, to evade the congestion, to effectively use a transmission line, and to transmit the data in real time and with high quality.



LEGAL STATUS

[Date of request for examination] 02.03.2000
[Date of sending the examiner's decision of rejection] 08.05.2001
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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JAPANESE [JP,08-163139,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The packet correspondence procedure characterized by what packet processing could be made to carry out with reference to the data in which the data in which communication link quality is shown are arranged in the packet communication mode which packet-izes a data signal according to each hierarchy's format with the communications protocol hierarchized by two or more hierarchies, and transmits it in common as each hierarchy's packet header, or a part of trailer, and said communication link quality is shown in each hierarchy.
[Claim 2] The packet correspondence procedure given in the 1st term characterized by using an abandonment priority as data in which communication link quality is shown.
[Claim 3] The packet correspondence procedure given in the 1st term characterized by using a congestion condition as data in which communication link quality is shown.
[Claim 4] The packet correspondence procedure given in the 1st term characterized by using a time delay as data in which communication link quality is shown.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the packet correspondence procedure which packet-izes and is transmitted using the protocol to which a data signal is specified according to a layered structure based on an OSI reference model in online communications.
[0002]
[Description of the Prior Art] In the packet communication mode (data communication system) which packet-izes a data signal according to each hierarchy's format with the communications protocol hierarchized by two or more layers represented by the OSI reference model, and transmits it, it has the format structure where each hierarchy consists of an independent header until now, and there was no function which delivers and receives the header information which shows the condition of a communication link quality demand or a network among hierarchies.
[0003] Actuation is explained about the case where the data (IP (Internet Protocol) packet data) of a computer are divided and transmitted to an ATM cel as an example, using ATM (Asynchronous Transfer Mode) as a physical layer. Drawing 6 shows mapping of the data in each hierarchy in case a TCP/IP protocol performs data transmission between computers, using ATM as the physical layer. 71 shows the format structure of a TCP packet, 72 is a TCP header and 21 is TCP data. 73 shows the format structure of an IP packet and 74 is IP header and a trailer for [22] ATM cels in IP data and 23. 75 shows the structure of an ATM cel, 76 is an ATM header and 24 is data division. 77 shows the structure of an ATM cel header, header length is fixed to 5 bytes and the data length is being fixed to 48 bytes. In addition, TCP and IP packet size are adjustable, and are a maximum of 64 K bytes.
[0004] In the case of data transmission, the data stream from the application of the upper layer is divided into a TCP segment (packet), and a TCP header is added. Next, this is mapped in an IP packet and IP header is added. Furthermore, an IP packet is mapped in an ATM cel. In the method of cel-izing to ATM, it is Types 1 and 2 and 3/4. And although there is a format called Type 5 and format structures differ, respectively, the case of Type 5 for data transmission is shown here. The header information used for the processing in each hierarchy has been independent in each hierarchy, and has composition which cannot use a layer, straddling so that drawing 6 may show.
[0005] Drawing 7 - drawing 10 show the example of a system configuration when performing online communications. This assumes the case where a certain computer communicates with another computer via an ATM node and an ATM router. Drawing where drawing 7 saw a system block Fig. and drawing 8 hierarchical, drawing in which drawing 9 shows the functional configuration of an ATM node, and drawing 10 are drawings showing the functional configuration of a router. In drawing 7 , the router with which 81 and 87 have the routing function of an IP packet as for a computer, 82, and 84 and 86, and 83 and 85 are ATM nodes which have the switching function of an ATM cel.
[0006] In drawing 8 , in 91, a network layer and 93 show a transport layer and, as for an ATM layer and 92, 94 shows the high order layer. Although an ATM layer consists of a physical layer, an ATM layer, and an AAL (ATM Adaptaion Layer) layer, it is summarized for convenience and

taken as the ATM layer. Moreover, although constituted from a session layer, the presentation layer, and the application layer by the high order layer at an OSI reference model, it is displaying as the upper layer collectively. Moreover, although a network consists of two or more nodes, it simplified by a diagram and two ATM nodes are indicated.
[0007] Drawing 9 is drawing showing the ATM node 83, and is 101. The ATM header discernment section and 102 The switching section and 103 It is a header adjunct. Drawing 10 is drawing showing a router 82, and is 111. The ATM header discernment section and 112 The data playback section and 113 IP header discernment section and 114 The routing processing section and 115 IP header adjunct and 116 The cellular splititting section and 117 It is a header adjunct.
[0008] In a computer 81, the data from the upper layer are divided into an ATM cel according to a format of previous drawing 6 , and are sent to a router 82. With a router, it is the ATM header discernment section 111 like drawing 10 . And the data playback section 112 IP data are reproduced except for ATM header information. IP header discernment section 113 IP header is then identified further and it is the routing processing section 114. Routing processing of the IP packet in a network layer is performed. IP header adjunct 115 IP header is added and it is the cellular splititting section 116. It sets, divides into an ATM cel and is the header adjunct 117. An ATM header is added and it sends out to the ATM node 83 as an ATM cel again.
[0009] It sets to the ATM node 83 and is the ATM header discernment section 101 like drawing 9 . A header is identified and it is the switching section 102. A cel is switched by the ATM layer and it is the header adjunct 103. An ATM header is added and it transmits to a router 84. Same processing is performed by further two or more nodes and two or more routers, and a computer 87 is reached. By computer 87, an IP packet is restored from an ATM cel, a TCP packet is reproduced from an IP packet, and data are passed to the application of the upper layer. Processing of each layer is performed based on each header and trailer information, and, in the usual case, it does not refer to about internal data.
[0010] In the system of drawing 7 – drawing 10 , abandonment of an ATM cel may take place by the congestion of a transmission line in the ATM node 83 or 85. Moreover, in routers 82 and 84 or 86, delay of data may occur by the overload of routing processing. By the conventional method, when congestion arose in an ATM layer, the processing in each layer was performing abandonment processing to each ATM cel, in order to process independently based on the header information for every layer.
[0011] For this reason, even when some ATM cels which constitute an IP packet were discarded and it became impossible to have used it as an IP packet, the remaining ATM cels which constitute that IP packet were sent out, and there was a fault of making congestion maintain. Moreover, delay arose in IP packet processing, and in the application as which real time nature is required, since the useless IP packet which became unusable was also transmitted, there was a fault that a transmission line could not be used effectively.
[0012]
[Problem(s) to be Solved by the Invention] In the online communications using the protocol specified according to a layered structure, by using in common the data in which communication link quality is shown on each hierarchy, the purpose of this invention prevents transmission of a useless packet, and is by using transmission-line capacity effectively to offer the approach of making a network utilization ratio high.
[0013]
[Means for Solving the Problem] In the packet communication mode which packet-izes a data signal according to each hierarchy's format with the communications protocol hierarchized by two or more hierarchies, and transmits it, this invention arranges the data in which communication link quality is shown in common as a part of DDA or trailer to each hierarchy's packet, and is characterized by what packet processing could be made to carry out with reference to the data in which this communication link quality is shown in each hierarchy. As data in which the communication link quality in this invention is shown, an abandonment priority, a congestion condition, a time delay, etc. can be used.
[0014]
[Function] In such this invention, since the data in which communication link quality is shown

have been arranged in common as each hierarchy's packet header, or a part of trailer, packet processing can be appropriately performed using the data in which this communication link quality is shown in each hierarchy.
[0015]
[Example] The packet format which is an example by this invention is shown in drawing 1 . Mapping of the data in each hierarchy in case a TCP/IP protocol performs data transmission between computers is shown using ATM as the physical layer. The same number is given about drawing 6 and a common thing. 11 shows the format structure of a TCP packet, 12 is a TCP header and 21 is TCP data. 14 shows the format structure of an IP packet and, as for IP header and 22, 15 is [IP data and 23] the trailers for ATM cels.
[0016] The parts 13, 16, and 19 which attached the slash in the header unit of each packet express the data which show each hierarchy by this invention the communication link quality arranged in common. Although arranged in a header in this drawing, you may arrange in a trailer. 17 shows the structure of an ATM cel, 18 is an ATM header and 24 is data division. 20 shows the example of structure of the header of the ATM cel fixed to the header length of 5 bytes, and the data length of 48 bytes. In addition, TCP and IP packet size are adjustable.
[0017] In the case of data transmission, the data stream from the application of the upper layer is divided into a TCP segment (packet), and a TCP header is added. At this time, the communication link quality desired value from the application of the upper layer is embedded at the part 13 in a TCP header. Next, this is mapped in an IP packet and IP header is added. At this time, the data corresponding to the part 13 in the aforementioned TCP header are embedded similarly at a part of IP header 16. Furthermore, an IP packet is mapped in an ATM cel. Also at this time, the data corresponding to a part of IP header 16 are mapped in the part 19 in an ATM header.
[0018] In the method of cel-izing to ATM, it is Types 1 and 2 and 3/4. And although there is a format called Type 5 and format structures differ, respectively, the case of Type 5 for data transmission is shown here. By Type 5, only a trailer is added to the tail of user data (IP packet), and it arranges to the data area of a cel.
[0019] The word length of the data 13 in the header arranged in common or a trailer, 16, and 19 does not necessarily need to be the same, and it is possible to use the value which corresponds based on the translation table beforehand created according to the data length of each layer. Moreover, it can be set as arbitration also about the location in a header or a trailer using preliminary data etc.
[0020] Drawing 2 - drawing 5 show the example of a system configuration when performing online communications. This assumes the case where a certain computer communicates with another computer via an ATM node and an ATM router. Drawing where drawing 2 saw a system block Fig. and drawing 3 hierarchical, drawing in which drawing 4 shows the functional configuration of an ATM node, and drawing 5 are drawings showing the functional configuration of a router. In drawing 2 , the router with which 31 and 37 have a computer and 32, 34, and 36 have the routing function of an IP packet, and 33 and 35 are ATM nodes which have the switching function of an ATM cel.
[0021] In drawing 3 , in an ATM layer and 42, a network layer and 43 express a transport layer and 44 expresses [41] the high order layer. Although an ATM layer consists of a physical layer, an ATM layer, and an AAL (ATM Adaptaion Layer) layer, it is summarized for convenience and taken as the ATM layer. Moreover, although constituted from a session layer, the presentation layer, and the application layer by the high order layer at an OSI reference model, it is displaying as the upper layer collectively. Moreover, although a network consists of two or more nodes, it simplified by a diagram and two ATM nodes are indicated.
[0022] Drawing 4 is drawing showing the ATM node 33, and, as for the ATM header discernment section and 52, 51 is [the switching section and 53] header adjuncts. drawing in which drawing 5 shows a router 32 — it is — 61 — for IP header discernment section and 64, as for IP header adjunct and 66, the routing processing section and 65 are [the ATM header discernment section and 62 / the data playback section and 63 / the cellular splititting section and 67] header adjuncts. Although the system shown in drawing 7 - drawing 10 and the fundamental function are

common, it differs in that the processing facility using the header information by this invention is contained.

[0023] In a computer 31, according to a format of previous drawing 1 , the data from the upper layer are divided into an ATM cel, and are sent to a router 32. In a router 32, IP data are reproduced by the ATM header discernment section 61 and the data playback section 62 except for ATM header information like drawing 5 . In IP-header discernment section 63, identify IP header further, and the routing processing section 64 performs routing processing of the IP packet in a network layer. IP header is added by IP header adjunct 65, it divides into an ATM cel in the cellular splititting section 66, an ATM header is added by the header adjunct 67, and it sends out to the ATM node 33 as an ATM cel again.

[0024] In the ATM node 33, a header is identified in the ATM header discernment section 51 like drawing 4 , a cel is switched by the ATM layer by the switching section 52, an ATM header is added by the header adjunct 53, and it transmits to a router 34. Same processing is performed by two or more nodes and two or more routers, and a computer 37 is reached. By computer 37, an IP packet is restored from an ATM cel, a TCP packet is reproduced from an IP packet, and data are passed to the application of the upper layer.

[0025] Based on the system configuration of drawing 2 , the example at the time of using an abandonment priority as a common header or trailer information (data in which communication link quality is shown) is explained. For example, in the ATM node 33, the congestion of a transmission line or the overload of switching processing of a cel may occur, and delay of data may occur by the overload of routing processing in a router 32.

[0026] When such and the congestion of a cel arises by the ATM layer in this invention, it is the ATM layer of the node. It is IP layer, when cel abandonment is performed according to the abandonment priority identified in the ATM header discernment section 51 of drawing 4 and the overload of routing processing arises in IP layer. Abandonment of an IP packet can be similarly performed according to the priority identified in IP header discernment section 63 of drawing 5 , and congestion processing is possible for the priority of the data independently discarded according to the throughput in each layer in common.

[0027] Thus, since congestion processing was conventionally performed only by the limited layer, when congestion occurred in another layer, big quality degradation had arisen, but since processing is possible with each layer according to an abandonment priority in this invention, it is possible to suppress quality degradation to the minimum.

[0028] Next, the example at the time of using a congestion condition as a common header or trailer information is explained. In the ATM node 33, congestion arises in an ATM layer and the case where cel abandonment occurs is assumed. In that case, IP header discernment section 63 can refer that abandonment occurred in the router of the next step by processing by IP layer by putting on IP header as a congestion condition by the ATM header discernment section 61 and the data playback section 62 of drawing 5 . Therefore, the advantage that the congestion [transmission / of a useless packet] after a stop and degree node is avoidable is acquired by discarding the whole IP packet.

[0029] Moreover, when a time delay is used as a common header or trailer information, routing processing etc. takes time amount and it becomes possible to aim at a deployment of a transmission line in the application as which real time nature is required by detecting the IP packet which became unusable by an intermediate router or an intermediate node, and discarding this. In addition, since the technique of synchronizing the time of day of each network node has already spread, calculation of a time delay is easily realizable.

[0030] Thus, since abandonment processing of a packet in_which cel abandonment processing or a time delay exceeded the allowed value since packet processing was able to be performed with reference to the data in which the data in which communication link quality is shown are arranged in common as each hierarchy's (layer) packet header or a part of trailer, and said communication link quality is shown in each hierarchy etc. is made to independence for every layer, transmission of a useless packet can be prevented and, according to this invention, congestion evasion and a deployment of a transmission line are possible.

[0031] Moreover, it is also possible to aim at implementation of real-time transmission or

implementation of high quality transmission by processing preferentially the packet as which a packet with a high priority or low delay is required with reference to the above-mentioned common header information.

[0032]

[Effect of the Invention] As explained above, according to this invention, it is possible by preventing transmission of a useless packet and using transmission-line capacity effectively to offer the network where a utilization ratio is high by using in common the data in which communication link quality is shown on each hierarchy in online communications. Furthermore, it is also possible to aim at implementation of real-time transmission or implementation of high quality transmission.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application] This invention relates to the packet correspondence procedure which packet-izes and is transmitted using the protocol to which a data signal is specified according to a layered structure based on an OSI reference model in online communications.

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PRIOR ART

[Description of the Prior Art] In the packet communication mode (data communication system) which packet-izes a data signal according to each hierarchy's format with the communications protocol hierarchized by two or more layers represented by the OSI reference model, and transmits it, it has the format structure where each hierarchy consists of an independent header until now, and there was no function which delivers and receives the header information which shows the condition of a communication link quality demand or a network among hierarchies.
[0003] Actuation is explained about the case where the data (IP (Internet Protocol) packet data) of a computer are divided and transmitted to an ATM cel as an example, using ATM (Asynchronous Transfer Mode) as a physical layer. Drawing 6 shows mapping of the data in each hierarchy in case a TCP/IP protocol performs data transmission between computers, using ATM as the physical layer. 71 shows the format structure of a TCP packet, 72 is a TCP header and 21 is TCP data. 73 shows the format structure of an IP packet and 74 is IP header and a trailer for [22] ATM cels in IP data and 23. 75 shows the structure of an ATM cel, 76 is an ATM header and 24 is data division. 77 shows the structure of an ATM cel header, header length is fixed to 5 bytes and the data length is being fixed to 48 bytes. In addition, TCP and IP packet size are adjustable, and are a maximum of 64 K bytes.
[0004] In the case of data transmission, the data stream from the application of the upper layer is divided into a TCP segment (packet), and a TCP header is added. Next, this is mapped in an IP packet and IP header is added. Furthermore, an IP packet is mapped in an ATM cel. In the method of cel-izing to ATM, it is Types 1 and 2 and 3/4. And although there is a format called Type 5 and format structures differ, respectively, the case of Type 5 for data transmission is shown here. The header information used for the processing in each hierarchy has been independent in each hierarchy, and has composition which cannot use a layer, straddling so that drawing 6 may show.
[0005] Drawing 7 - drawing 10 show the example of a system configuration when performing online communications. This assumes the case where a certain computer communicates with another computer via an ATM node and an ATM router. Drawing where drawing 7 saw a system block Fig. and drawing 8 hierarchical, drawing in which drawing 9 shows the functional configuration of an ATM node, and drawing 10 are drawings showing the functional configuration of a router. In drawing 7 , the router with which 81 and 87 have the routing function of an IP packet as for a computer, 82, and 84 and 86, and 83 and 85 are ATM nodes which have the switching function of an ATM cel.
[0006] In drawing 8 , in 91, a network layer and 93 show a transport layer and, as for an ATM layer and 92, 94 shows the high order layer. Although an ATM layer consists of a physical layer, an ATM layer, and an AAL (ATM Adaptaion Layer) layer, it is summarized for convenience and taken as the ATM layer. Moreover, although constituted from a session layer, the presentation layer, and the application layer by the high order layer at an OSI reference model, it is displaying as the upper layer collectively. Moreover, although a network consists of two or more nodes, it simplified by a diagram and two ATM nodes are indicated.
[0007] Drawing 9 is drawing showing the ATM node 83, and is 101. The ATM header discernment section and 102 The switching section and 103 It is a header adjunct. Drawing 10 is drawing

showing a router 82, and is 111. The ATM header discernment section and 112 The data playback section and 113 IP header discernment section and 114 The routing processing section and 115 IP header adjunct and 116 The cellular splititting section and 117 It is a header adjunct.
[0008] In a computer 81, the data from the upper layer are divided into an ATM cel according to a format of previous drawing 6 , and are sent to a router 82. With a router, it is the ATM header discernment section 111 like drawing 10 . And the data playback section 112 IP data are reproduced except for ATM header information. IP header discernment section 113 IP header is then identified further and it is the routing processing section 114. Routing processing of the IP packet in a network layer is performed. IP header adjunct 115 IP header is added and it is the cellular splititting section 116. It sets, divides into an ATM cel and is the header adjunct 117. An ATM header is added and it sends out to the ATM node 83 as an ATM cel again.
[0009] It sets to the ATM node 83 and is the ATM header discernment section 101 like drawing 9 . A header is identified and it is the switching section 102. A cel is switched by the ATM layer and it is the header adjunct 103. An ATM header is added and it transmits to a router 84. Same processing is performed by further two or more nodes and two or more routers, and a computer 87 is reached. By computer 87, an IP packet is restored from an ATM cel, a TCP packet is reproduced from an IP packet, and data are passed to the application of the upper layer. Processing of each layer is performed based on each header and trailer information, and, in the usual case, it does not refer to about internal data.
[0010] In the system of drawing 7 - drawing 10 , abandonment of an ATM cel may take place by the congestion of a transmission line in the ATM node 83 or 85. Moreover, in routers 82 and 84 or 86, delay of data may occur by the overload of routing processing. By the conventional method, when congestion arose in an ATM layer, the processing in each layer was performing abandonment processing to each ATM cel, in order to process independently based on the header information for every layer.
[0011] For this reason, even when some ATM cels which constitute an IP packet were discarded and it became impossible to have used it as an IP packet, the remaining ATM cels which constitute that IP packet were sent out, and there was a fault of making congestion maintain. Moreover, delay arose in IP packet processing, and in the application as which real time nature is required, since the useless IP packet which became unusable was also transmitted, there was a fault that a transmission line could not be used effectively.

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EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, according to this invention, it is possible by preventing transmission of a useless packet and using transmission-line capacity effectively to offer the network where a utilization ratio is high by using in common the data in which communication link quality is shown on each hierarchy in online communications. Furthermore, it is also possible to aim at implementation of real-time transmission or implementation of high quality transmission.

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OPERATION

[Function] In such this invention, since the data in which communication link quality is shown have been arranged in common as each hierarchy's packet header, or a part of trailer, packet processing can be appropriately performed using the data in which this communication link quality is shown in each hierarchy.

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EXAMPLE

[Example] The packet format which is an example by this invention is shown in drawing 1 . Mapping of the data in each hierarchy in case a TCP/IP protocol performs data transmission between computers is shown using ATM as the physical layer. The same number is given about drawing 6 and a common thing. 11 shows the format structure of a TCP packet, 12 is a TCP header and 21 is TCP data. 14 shows the format structure of an IP packet and, as for IP header and 22, 15 is [IP data and 23] the trailers for ATM cels.
[0016] The parts 13, 16, and 19 which attached the slash in the header unit of each packet express the data which show each hierarchy by this invention the communication link quality arranged in common. Although arranged in a header in this drawing, you may arrange in a trailer. 17 shows the structure of an ATM cel, 18 is an ATM header and 24 is data division. 20 shows the example of structure of the header of the ATM cel fixed to the header length of 5 bytes, and the data length of 48 bytes. In addition, TCP and IP packet size are adjustable.
[0017] In the case of data transmission, the data stream from the application of the upper layer is divided into a TCP segment (packet), and a TCP header is added. At this time, the communication link quality desired value from the application of the upper layer is embedded at the part 13 in a TCP header. Next, this is mapped in an IP packet and IP header is added. At this time, the data corresponding to the part 13 in the aforementioned TCP header are embedded similarly at a part of IP header 16. Furthermore, an IP packet is mapped in an ATM cel. Also at this time, the data corresponding to a part of IP header 16 are mapped in the part 19 in an ATM header.
[0018] In the method of cel-izing to ATM, it is Types 1 and 2 and 3/4. And although there is a format called Type 5 and format structures differ, respectively, the case of Type 5 for data transmission is shown here. By Type 5, only a trailer is added to the tail of user data (IP packet), and it arranges to the data area of a cel.
[0019] The word length of the data 13 in the header arranged in common or a trailer, 16, and 19 does not necessarily need to be the same, and it is possible to use the value which corresponds based on the translation table beforehand created according to the data length of each layer. Moreover, it can be set as arbitration also about the location in a header or a trailer using preliminary data etc.
[0020] Drawing 2 - drawing 5 show the example of a system configuration when performing online communications. This assumes the case where a certain computer communicates with another computer via an ATM node and an ATM router. Drawing where drawing 2 saw a system block Fig. and drawing 3 hierarchical, drawing in which drawing 4 shows the functional configuration of an ATM node, and drawing 5 are drawings showing the functional configuration of a router. In drawing 2 , the router with which 31 and 37 have a computer and 32, 34, and 36 have the routing function of an IP packet, and 33 and 35 are ATM nodes which have the switching function of an ATM cel.
[0021] In drawing 3 , in an ATM layer and 42, a network layer and 43 express a transport layer and 44 expresses [41] the high order layer. Although an ATM layer consists of a physical layer, an ATM layer, and an AAL (ATM Adaptaion Layer) layer, it is summarized for convenience and taken as the ATM layer. Moreover, although constituted from a session layer, the presentation

layer, and the application layer by the high order layer at an OSI reference model, it is displaying as the upper layer collectively. Moreover, although a network consists of two or more nodes, it simplified by a diagram and two ATM nodes are indicated.
[0022] Drawing 4 is drawing showing the ATM node 33, and, as for the ATM header discernment section and 52, 51 is [the switching section and 53] header adjuncts. drawing in which drawing 5 shows a router 32 — it is — 61 — for IP header discernment section and 64, as for IP header adjunct and 66, the routing processing section and 65 are [the ATM header discernment section and 62 / the data playback section and 63 / the cellular splititting section and 67] header adjuncts. Although the system shown in drawing 7 - drawing 10 and the fundamental function are common, it differs in that the processing facility using the header information by this invention is contained.
[0023] In a computer 31, according to a format of previous drawing 1 , the data from the upper layer are divided into an ATM cel, and are sent to a router 32. In a router 32, IP data are reproduced by the ATM header discernment section 61 and the data playback section 62 except for ATM header information like drawing 5 . In IP header discernment section 63, identify IP header further, and the routing processing section 64 performs routing processing of the IP packet in a network layer. IP header is added by IP header adjunct 65, it divides into an ATM cel in the cellular splititting section 66, an ATM header is added by the header adjunct 67, and it sends out to the ATM node 33 as an ATM cel again.
[0024] In the ATM node 33, a header is identified in the ATM header discernment section 51 like drawing 4 , a cel is switched by the ATM layer by the switching section 52, an ATM header is added by the header adjunct 53, and it transmits to a router 34. Same processing is performed by two or more nodes and two or more routers, and a computer 37 is reached. By computer 37, an IP packet is restored from an ATM cel, a TCP packet is reproduced from an IP packet, and data are passed to the application of the upper layer.
[0025] Based on the system configuration of drawing 2 , the example at the time of using an abandonment priority as a common header or trailer information (data in which communication link quality is shown) is explained. For example, in the ATM node 33, the congestion of a transmission line or the overload of switching processing of a cel may occur, and delay of data may occur by the overload of routing processing in a router 32.
[0026] When such and the congestion of a cel arises by the ATM layer in this invention, it is the ATM layer of the node. It is IP layer, when cel abandonment is performed according to the abandonment priority identified in the ATM header discernment section 51 of drawing 4 and the overload of routing processing arises in IP layer. Abandonment of an IP packet can be similarly performed according to the priority identified in IP header discernment section 63 of drawing 5 , and congestion processing is possible for the priority of the data independently discarded according to the throughput in each layer in common.
[0027] Thus, since congestion processing was conventionally performed only by the limited layer, when congestion occurred in another layer, big quality degradation had arisen, but since processing is possible with each layer according to an abandonment priority in this invention, it is possible to suppress quality degradation to the minimum.
[0028] Next, the example at the time of using a congestion condition as a common header or trailer information is explained. In the ATM node 33, congestion arises in an ATM layer and the case where cel abandonment occurs is assumed. In that case, IP header discernment section 63 can refer that abandonment occurred in the router of the next step by processing by IP layer by putting on IP header as a congestion condition by the ATM header discernment section 61 and the data playback section 62 of drawing 5 . Therefore, the advantage that the congestion [transmission / of a useless packet] after a stop and degree node is avoidable is acquired by discarding the whole IP packet.
[0029] Moreover, when a time delay is used as a common header or trailer information, routing processing etc. takes time amount and it becomes possible to aim at a deployment of a transmission line in the application as which real time nature is required by detecting the IP packet which became unusable by an intermediate router or an intermediate node, and discarding this. In addition, since the technique of synchronizing the time of day of each network node has

already spread, calculation of a time delay is easily realizable.
[0030] Thus, since abandonment processing of a packet in_which cel abandonment processing or a time delay exceeded the allowed value since packet processing was able to be performed with reference to the data in which the data in which communication link quality is shown are arranged in common as each hierarchy's (layer) packet header or a part of trailer, and said communication link quality is shown in each hierarchy etc. is made to independence for every layer, transmission of a useless packet can be prevented and, according to this invention, congestion evasion and a deployment of a transmission line are possible.
[0031] Moreover, it is also possible to aim at implementation of real-time transmission or implementation of high quality transmission by processing preferentially the packet as which a packet with a high priority or low delay is required with reference to the above-mentioned common header information.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the packet format of the example by this invention.
[Drawing 2] It is the block diagram of the configuration of the example by this invention.
[Drawing 3] It is drawing which found the configuration of the example by this invention hierarchical.
[Drawing 4] It is drawing showing the functional configuration of the ATM node of the example by this invention.
[Drawing 5] It is drawing showing the functional configuration of the router of the example by this invention.
[Drawing 6] It is drawing showing the packet format of the conventional example.
[Drawing 7] It is the block diagram of the configuration of the conventional example.
[Drawing 8] It is drawing which found the configuration of the conventional example hierarchical.
[Drawing 9] It is drawing showing the functional configuration of the ATM node of the conventional example.
[Drawing 10] It is drawing showing the functional configuration of the router of the conventional example.
[Description of Notations]
11 Format Structure of TCP Packet
12 TCP Header
13, 16, 19 Data which show each hierarchy the communication link quality arranged in common
14 Format Structure of IP Packet
15 IP Header
17 Structure of ATM Cel
18 ATM Header
20 Example of Structure of Header of ATM Cel
21 TCP Data
22 IP Data
23 Trailer for ATM Cels
24 Data Division
31 37 Computer
32, 34, 36 Router which has the routing function of an IP packet
33 35 ATM node which has the switching function of an ATM cel
41 ATM Layer
42 Network Layer
43 Transport Layer
44 High Order Layer
51 ATM Header Discernment Section
52 Switching Section
53 Header Adjunct
61 ATM Header Discernment Section
62 Data Playback Section

63 IP Header Discernment Section
64 Routing Processing Section
65 IP Header Adjunct
66 Cellular Splititting Section
67 Header Adjunct
71 Format Structure of TCP Packet
72 TCP Header
73 Format Structure of IP Packet
74 IP Header
75 Structure of ATM Cel
76 ATM Header
77 Example of Structure of Header of ATM Cel
81 87 Computer
82, 84, 86 Router which has the routing function of an IP packet
83 85 ATM node which has the switching function of an ATM cel
91 ATM Layer
92 Network Layer
93 Transport Layer
94 High Order Layer
101 ATM Header Discernment Section
102 Switching Section
103 Header Adjunct
111 ATM Header Discernment Section
112 Data Playback Section
113 IP Header Discernment Section
114 Routing Processing Section
115 IP Header Adjunct
116 Cellular Splititting Section
117 Header Adjunct

[Translation done.]

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(19)日本国特許庁（ＪＰ） (12) 公開特許公報（A） (11)特許出願公開番号

特開平8－163139

(43)公開日 平成８年(1996)６月21日

(51)Int.Cl.*	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０４Ｌ 12/28				
Ｈ０４Ｑ 3/00				
		9466－5K	Ｈ０４Ｌ 11/ 20	G

審査請求 未請求 請求項の数４ ＯＬ （全 ６ 頁）

(21)出願番号 特願平6－300888

(22)出願日 平成６年(1994)12月５日

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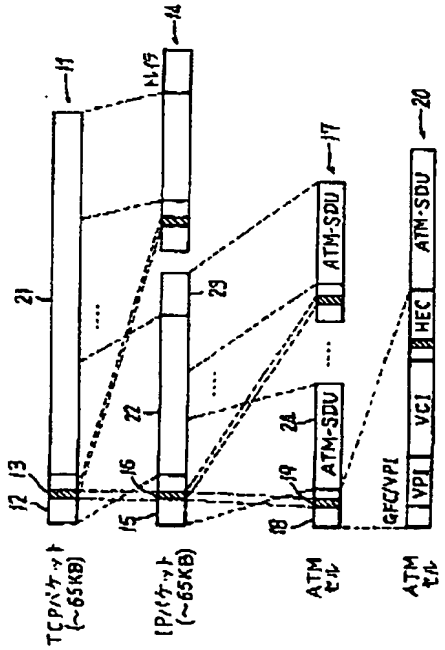
(54)【発明の名称】 パケット通信方法

(57)【要約】

【目的】 コンピュータ通信のネットワークの使用効率を高める方法を提供する。

【構成】 データ信号を複数の階層に階層化された通信プロトコルにより各階層のフォーマットに従ってパケット化して伝送するパケット通信方式において、通信品質を示すデータを各階層のパケットヘッダ又はトレイラの一部として共通的に配置し、各階層においてこの通信品質を示すデータを参照してパケット処理をできるようにする。この通信品質を示すデータとしては、廃棄優先度、輻輳状態、遅延時間等を用いることができる。



【特許請求の範囲】

【請求項１】 データ信号を複数の階層に階層化された通信プロトコルにより各階層のフォーマットに従ってパケット化して伝送するパケット通信方式において、通信品質を示すデータを各階層のパケットヘッダ又はトレイラの一部として共通的に配置し、各階層において前記通信品質を示すデータを参照してパケット処理をできるようにしたことを特徴とするパケット通信方法。

【請求項２】 通信品質を示すデータとして廃棄優先度を用いたことを特徴とする第１項記載のパケット通信方法。

【請求項３】 通信品質を示すデータとして輻輳状態を用いたことを特徴とする第１項記載のパケット通信方法。

【請求項４】 通信品質を示すデータとして遅延時間を用いたことを特徴とする第１項記載のパケット通信方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、コンピュータ通信において、データ信号を例えばＯＳＩ参照モデルに基づいて階層構造で規定されるプロトコルを用いてパケット化して伝送するパケット通信方法に関するものである。

【０００２】

【従来の技術】これまで、データ信号をＯＳＩ参照モデルに代表される複数のレイヤに階層化された通信プロトコルにより各階層のフォーマットに従ってパケット化して伝送するパケット通信方式（データ通信方式）においては、各階層が独立のヘッダからなるフォーマット構造を有し、階層間で通信品質要求あるいはネットワークの状態を示すヘッダ情報を授受する機能がなかった。

【０００３】一例として、ＡＴＭ（Asynchronous Transfer Mode）を物理レイヤとして用い、コンピュータのデータ（ＩＰ（Internet Protocol ）パケットデータ）をＡＴＭセルに分割して伝送する場合について動作を説明する。図６は、物理層としてＡＴＭを用い、ＴＣＰ／ＩＰプロトコルによりコンピュータ間でデータ伝送を行う場合の各階層におけるデータのマッピングを示している。71はＴＣＰパケットのフォーマット構造を示しており、72はＴＣＰヘッダ、21はＴＣＰデータである。73はＩＰパケットのフォーマット構造を示しており、74はＩＰヘッダ、22はＩＰデータ、23はＡＴＭセル用のトレイラである。75はＡＴＭセルの構造を示しており、76はＡＴＭヘッダ、24はデータ部である。77はＡＴＭセルヘッダの構造を示しており、ヘッダ長は５バイト、データ長は４８バイトに固定されている。なお、ＴＣＰおよびＩＰパケット長は可変であり、最大６４Ｋバイトである。

【０００４】データ伝送の際、上位層のアプリケーションからのデータストリームをＴＣＰセグメント（パケット）に分割し、ＴＣＰヘッダを付加する。次にこれをＩＰパケットにマッピングしてＩＰヘッダを付加する。さらにＩＰパケットをＡＴＭセルにマッピングする。ＡＴＭへのセル化の方式にはタイプ１、２、3/4 およびタイプ５と呼ばれる形式があり、それぞれフォーマット構造が異なるが、ここではデータ伝送を対象としたタイプ５の場合を示している。図６からわかるように、各階層における処理に使用するヘッダ情報はそれぞれの階層において独立しており、レイヤを跨って使用することはできない構成となっている。

【０００５】図７～図１０はコンピュータ通信を行うときのシステム構成例を示している。これは、或るコンピュータがＡＴＭノードおよびＡＴＭルータを経由して別のコンピュータと通信する場合を想定している。図７はシステムブロック図、図８は階層的にみた図、図９はＡＴＭノードの機能構成を示す図、図１０はルータの機能構成を示す図である。図７において、81および87はコンピュータ、82，84および86はＩＰパケットのルーティング機能を有するルータ、83および85はＡＴＭセルのスイッチング機能を有するＡＴＭノードである。

【０００６】図８において、91はＡＴＭレイヤ、92はネットワークレイヤ、93はトランスポートレイヤ、94は上位レイヤを示している。ＡＴＭレイヤは物理レイヤ、ＡＴＭレイヤ、ＡＡＬ（ＡＴＭ Adaptaion Layer）レイヤからなるが、便宜的にまとめてＡＴＭレイヤとしている。また、上位レイヤについてもＯＳＩ参照モデルではセッション層、プレゼンテーション層、アプリケーション層から構成されるが、まとめて上位層として表示している。また、ネットワークは複数のノードから構成されるが、図では簡略化して二つのＡＴＭノードを記載している。

【０００７】図９はＡＴＭノード83を示す図で、101 はＡＴＭヘッダ識別部、102 はスイッチング部、103 はヘッダ付加部である。図１０はルータ82を示す図で、111 はＡＴＭヘッダ識別部、112 はデータ再生部、113 はＩＰヘッダ識別部、114 はルーティング処理部、115 はＩＰヘッダ付加部、116 はセル分割部、117 はヘッダ付加部である。

【０００８】コンピュータ81において、上位層からのデータは先の図６のフォーマットに従ってＡＴＭセルに分割されルータ82に送られる。ルータでは図１０のように、ＡＴＭヘッダ識別部111 およびデータ再生部112 によりＡＴＭヘッダ情報を除いてＩＰデータを再生し、ＩＰヘッダ識別部113 ではさらにＩＰヘッダを識別してルーティング処理部114 によりネットワーク層におけるＩＰパケットのルーティング処理を行い、ＩＰヘッダ付加部115 でＩＰヘッダを付加し、セル分割部116 においてＡＴＭセルに分割し、ヘッダ付加部117 によりＡＴＭヘッダを付加して再びＡＴＭセルとしてＡＴＭノード83に送出する。

【０００９】ＡＴＭノード83においては図９のように、

ＡＴＭヘッダ識別部101 でヘッダを識別し、スイッチング部102 によりＡＴＭレイヤでセルのスイッチングを行い、ヘッダ付加部103 によりＡＴＭヘッダを付加してルータ84に転送する。さらに複数のノードと複数のルータで同様の処理が行われ、コンピュータ87に到達する。コンピュータ87ではＡＴＭセルからＩＰパケットを復元し、ＩＰパケットからＴＣＰパケットを再生し、上位層のアプリケーションにデータを渡す。各レイヤの処理は、それぞれのヘッダおよびトレイラ情報に基づいて行われ、通常の場合、内部のデータについては参照しない。

【００１０】図７～図１０のシステムにおいて、ＡＴＭノード83あるいは85において、伝送路の輻輳によりＡＴＭセルの廃棄が起こり得る。また、ルータ82、84あるいは86においてはルーティング処理の過負荷によりデータの遅延が発生することがある。従来の方式では、各レイヤにおける処理はレイヤ毎のヘッダ情報に基づいて独立に処理を行うため、ＡＴＭレイヤで輻輳が生じた場合は個々のＡＴＭセルに対して廃棄処理を行っていた。

【００１１】このため、ＩＰパケットを構成するＡＴＭセルが何個か廃棄され、ＩＰパケットとして使用できなくなった場合でも、そのＩＰパケットを構成する残りのＡＴＭセルを送出し、輻輳を持続させるという欠点があった。また、ＩＰパケット処理に遅延が生じ、リアルタイム性が要求されるアプリケーションでは使用不可能になった無駄なＩＰパケットも伝送されていたため、伝送路を有効利用できないという欠点があった。

【００１２】

【発明が解決しようとする課題】本発明の目的は、階層構造で規定されるプロトコルを用いたコンピュータ通信において、各階層で通信品質を示すデータを共通的に利用することにより無駄なパケットの伝送を防止し、伝送路容量を有効に利用することによりネットワークの使用効率を高くする方法を提供することにある。

【００１３】

【課題を解決するための手段】本発明は、データ信号を複数の階層に階層化された通信プロトコルにより各階層のフォーマットに従ってパケット化して伝送するパケット通信方式において、通信品質を示すデータを各階層のパケットヘッダ又はトレイラの一部として共通的に配置し、各階層においてこの通信品質を示すデータを参照してパケット処理をできるようにしたことを特徴とする。本発明における通信品質を示すデータとしては、廃棄優先度、輻輳状態、遅延時間等を用いることができる。

【００１４】

【作用】このような本発明においては、通信品質を示すデータを各階層のパケットヘッダあるいはトレイラの一部として共通的に配置したので、各階層においてこの通信品質を示すデータを用いてパケット処理を適切に行うことができる。

【００１５】

【実施例】本発明による実施例であるパケットフォーマットを図１に示す。物理層としてＡＴＭを用い、ＴＣＰ／ＩＰプロトコルによりコンピュータ間でデータ伝送を行う場合の各階層におけるデータのマッピングを示している。図６と共通のものについては同一番号を付与している。11はＴＣＰパケットのフォーマット構造を示しており、12はＴＣＰヘッダ、21はＴＣＰデータである。14はＩＰパケットのフォーマット構造を示しており、15はＩＰヘッダ、22はＩＰデータ、23はＡＴＭセル用トレイラである。

【００１６】各パケットのヘッダ部において斜線を付けた部分13、16および19は本発明による各階層に共通的に配置された通信品質を示すデータを表している。この図ではヘッダ内に配置しているが、トレイラ内に配置してもよい。17はＡＴＭセルの構造を示しており、18はＡＴＭヘッダ、24はデータ部である。20はヘッダ長５バイト、データ長４８バイトに固定されたＡＴＭセルのヘッダの構造例を示したものである。なお、ＴＣＰおよびＩＰパケット長は可変である。

【００１７】データ伝送の際、上位層のアプリケーションからのデータストリームをＴＣＰセグメント（パケット）に分割し、ＴＣＰヘッダを付加する。このとき、上位層のアプリケーションからの通信品質要求値をＴＣＰヘッダ内の一部13に埋め込む。次にこれをＩＰパケットにマッピングし、ＩＰヘッダを付加する。このとき、同様に前記のＴＣＰヘッダ内の一部13に対応するデータをＩＰヘッダの一部16に埋め込む。さらにＩＰパケットをＡＴＭセルにマッピングする。このときもＩＰヘッダの一部16に対応するデータをＡＴＭヘッダ内の一部19にマッピングする。

【００１８】ＡＴＭへのセル化の方式にはタイプ１、２、3/4 およびタイプ５と呼ばれる形式があり、それぞれフォーマット構造が異なるが、ここではデータ伝送を対象としたタイプ５の場合を示している。タイプ５ではユーザデータ（ＩＰパケット）の末尾にトレイラのみを付加してセルのデータ領域に配置する。

【００１９】共通的に配置するヘッダあるいはトレイラ内のデータ13，16，19の語長は必ずしも同一である必要はなく、各レイヤのデータ長に合わせて予め作成された変換テーブルに基づいて対応する値を使用することが可能である。また、ヘッダあるいはトレイラ内の位置についても予備データ等を利用して任意に設定できる。

【００２０】図２～図５はコンピュータ通信を行うときのシステム構成例を示している。これは、或るコンピュータがＡＴＭノードおよびＡＴＭルータを経由して別のコンピュータと通信する場合を想定している。図２はシステムブロック図、図３は階層的にみた図、図４はＡＴＭノードの機能構成を示す図、図５はルータの機能構成を示す図である。図２において、31および37はコンピュ

一タ、32、34および36はＩＰパケットのルーティング機能を有するルータ、33および35はＡＴＭセルのスイッチング機能を有するＡＴＭノードである。

【００２１】図３において、41はＡＴＭレイヤ、42はネットワークレイヤ、43はトランスポートレイヤ、44は上位レイヤを表している。ＡＴＭレイヤは物理レイヤ、ＡＴＭレイヤ、ＡＡＬ（ＡＴＭ Adaptaion Layer）レイヤからなるが、便宜的にまとめてＡＴＭレイヤとしている。また、上位レイヤについてもＯＳＩ参照モデルではセッション層、プレゼンテーション層およびアプリケーション層から構成されるが、まとめて上位層として表示している。また、ネットワークは複数のノードから構成されるが、図では簡略化して二つのＡＴＭノードを記載している。

【００２２】図４はＡＴＭノード33を示す図であり、51はＡＴＭヘッダ識別部、52はスイッチング部、53はヘッダ付加部である。図５はルータ32を示す図であり、61はＡＴＭヘッダ識別部、62はデータ再生部、63はＩＰヘッダ識別部、64はルーティング処理部、65はＩＰヘッダ付加部、66はセル分割部、67はヘッダ付加部である。図７～図１０に示したシステムと基本的な機能は共通しているが、本発明によるヘッダ情報を用いた処理機能が含まれている点が異なっている。

【００２３】コンピュータ31においては、上位層からのデータは先の図１のフォーマットに従って、ＡＴＭセルに分割されてルータ32に送られる。ルータ32では図５のように、ＡＴＭヘッダ識別部61およびデータ再生部62によりＡＴＭヘッダ情報を除いてＩＰデータが再生され、ＩＰヘッダ識別部63ではさらにＩＰヘッダを識別し、ルーティング処理部64によりネットワーク層におけるＩＰパケットのルーティング処理を行い、ＩＰヘッダ付加部65でＩＰヘッダを付加し、セル分割部66においてＡＴＭセルに分割し、ヘッダ付加部67によりＡＴＭヘッダを付加して再びＡＴＭセルとしてＡＴＭノード33に送出する。

【００２４】ＡＴＭノード33においては、図４のようにＡＴＭヘッダ識別部51でヘッダを識別し、スイッチング部52によりＡＴＭレイヤでセルのスイッチングを行い、ヘッダ付加部53によりＡＴＭヘッダを付加してルータ34に伝送する。複数のノードと複数のルータで同様の処理が行われ、コンピュータ37に到達する。コンピュータ37ではＡＴＭセルからＩＰパケットを復元し、ＩＰパケットからＴＣＰパケットを再生し、上位層のアプリケーションにデータを渡す。

【００２５】図２のシステム構成に基づいて、共通のヘッダあるいはトレイラ情報（通信品質を示すデータ）として廃棄優先度を用いた場合の実施例について説明する。例えばＡＴＭノード33で伝送路の輻輳あるいはセルのスイッチング処理の過負荷が発生したり、また、ルータ32においてはルーティング処理の過負荷によりデータの遅滞が発生することがある。

【００２６】このようなとき本発明では、ＡＴＭレイヤでセルの輻輳が生じた場合はそのノードのＡＴＭレイヤで、図４のＡＴＭヘッダ識別部51で識別した廃棄優先度に応じてセル廃棄を行い、ＩＰレイヤでルーティング処理の過負荷が生じた場合はＩＰレイヤで、同様にＩＰパケットの廃棄を図５のＩＰヘッダ識別部63で識別した優先度に応じて行うことができ、各レイヤにおける処理能力に従って独立に、かつ廃棄するデータの優先度は共通して輻輳処理が可能である。

【００２７】このように、従来は限られたレイヤだけで輻輳処理を行っていたので別のレイヤで輻輳が発生した場合大きな品質劣化が生じていたが、本発明では各レイヤで廃棄優先度に応じて処理ができるため、品質劣化を最小限に抑えることが可能である。

【００２８】次に、共通のヘッダあるいはトレイラ情報として輻輳状態を用いた場合の実施例について説明する。ＡＴＭノード33において、ＡＴＭレイヤで輻輳が生じ、セル廃棄が発生した場合を想定する。その場合、次段のルータにおいて廃棄が発生したことを図５のＡＴＭヘッダ識別部61およびデータ再生部62により、輻輳状態としてＩＰヘッダに乗せることによりＩＰレイヤでの処理でＩＰヘッダ識別部63により参照することができる。従って、そのＩＰパケット全体を廃棄することにより、無駄なパケットの伝送を止め、次ノード以降における輻輳を回避できるという利点が得られる。

【００２９】また、共通のヘッダあるいはトレイラ情報として遅延時間を用いた場合、例えばルーティング処理等に時間がかかり、リアルタイム性が要求されるアプリケーションでは使用不可能になったＩＰパケットを途中のルータあるいはノードで検出し、これを廃棄することにより、伝送路の有効利用を図ることが可能となる。なお、各ネットワークノードの時刻を同期させる技術は既に普及しているため、遅延時間の算出は容易に実現可能である。

【００３０】このように本発明によれば、通信品質を示すデータを各階層（レイヤ）のパケットヘッダあるいはトレイラの一部として共通的に配置し、各階層において前記通信品質を示すデータを参照してパケット処理を行なえるため、セル廃棄処理あるいは遅延時間が許容値を越えたパケットの廃棄処理等を各レイヤ毎に独立にできるため、無駄なパケットの伝送を防止でき、輻輳回避および伝送路の有効利用が可能である。

【００３１】また、上記の共通ヘッダ情報を参照して優先度の高いパケットあるいは低遅延が要求されるパケットを優先的に処理することにより、リアルタイム伝送の実現あるいは高品質伝送の実現を図ることも可能である。

【００３２】

【発明の効果】以上説明したように、本発明によればコ

ンピュータ通信において、各階層で通信品質を示すデータを共通的に利用することにより無駄なパケットの伝送を防止し、伝送路容量を有効に利用することにより使用効率の高いネットワークを提供することが可能である。さらに、リアルタイム伝送の実現あるいは高品質伝送の実現を図ることも可能である。

【図面の簡単な説明】

【図１】本発明による実施例のパケットフォーマットを示す図である。

【図２】本発明による実施例の構成のブロック図である。

【図３】本発明による実施例の構成を階層的にみた図である。

【図４】本発明による実施例のＡＴＭノードの機能構成を示す図である。

【図５】本発明による実施例のルータの機能構成を示す図である。

【図６】従来例のパケットフォーマットを示す図である。

【図７】従来例の構成のブロック図である。

【図８】従来例の構成を階層的にみた図である。

【図９】従来例のＡＴＭノードの機能構成を示す図である。

【図１０】従来例のルータの機能構成を示す図である。

【符号の説明】

１１　ＴＣＰパケットのフォーマット構造

１２　ＴＣＰヘッダ

１３、１６、１９　各階層に共通的に配置された通信品質を示すデータ

１４　ＩＰパケットのフォーマット構造

１５　ＩＰヘッダ

１７　ＡＴＭセルの構造

１８　ＡＴＭヘッダ

２０　ＡＴＭセルのヘッダの構造例

２１　ＴＣＰデータ

２２　ＩＰデータ

２３　ＡＴＭセル用のトレイラ

２４　データ部

３１、３７　コンピュータ

３２、３４、３６　ＩＰパケットのルーティング機能を有するルータ

３３、３５　ＡＴＭセルのスイッチング機能を有するＡＴＭノード

４１　ＡＴＭレイヤ

４２　ネットワークレイヤ

４３　トランスポートレイヤ

４４　上位レイヤ

５１　ＡＴＭヘッダ識別部

５２　スイッチング部

５３　ヘッダ付加部

６１　ＡＴＭヘッダ識別部

６２　データ再生部

６３　ＩＰヘッダ識別部

６４　ルーティング処理部

６５　ＩＰヘッダ付加部

６６　セル分割部

６７　ヘッダ付加部

７１　ＴＣＰパケットのフォーマット構造

７２　ＴＣＰヘッダ

７３　ＩＰパケットのフォーマット構造

７４　ＩＰヘッダ

７５　ＡＴＭセルの構造

７６　ＡＴＭヘッダ

７７　ＡＴＭセルのヘッダの構造例

８１、８７　コンピュータ

８２、８４、８６　ＩＰパケットのルーティング機能を有するルータ

８３、８５　ＡＴＭセルのスイッチング機能を有するＡＴＭノード

９１　ＡＴＭレイヤ

９２　ネットワークレイヤ

９３　トランスポートレイヤ

９４　上位レイヤ

１０１　ＡＴＭヘッダ識別部

１０２　スイッチング部

１０３　ヘッダ付加部

１１１　ＡＴＭヘッダ識別部

１１２　データ再生部

１１３　ＩＰヘッダ識別部

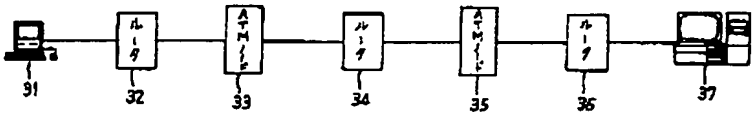
１１４　ルーティング処理部

１１５　ＩＰヘッダ付加部

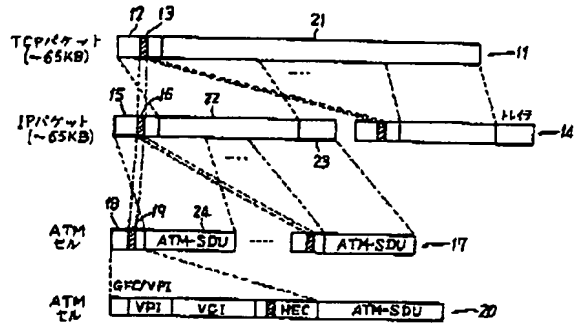
１１６　セル分割部

１１７　ヘッダ付加部

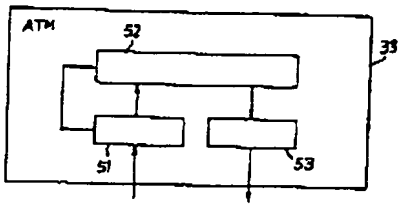
【図２】



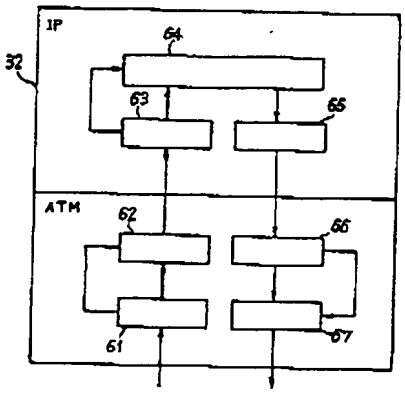
【図1】



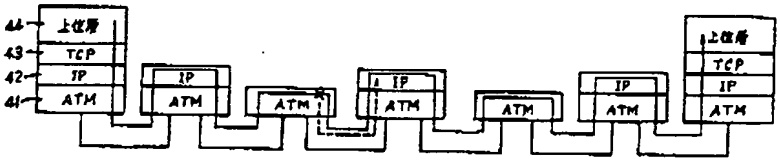
【図4】



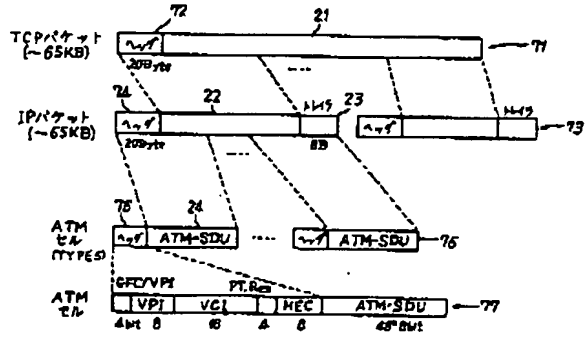
【図5】



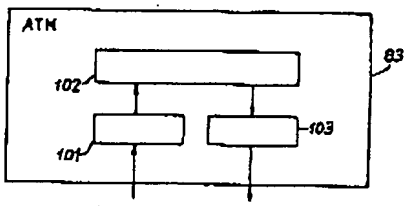
【図3】



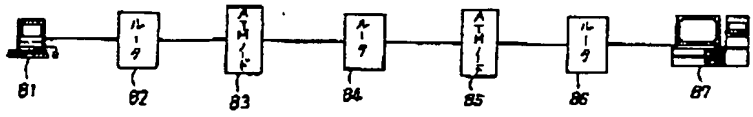
【図6】



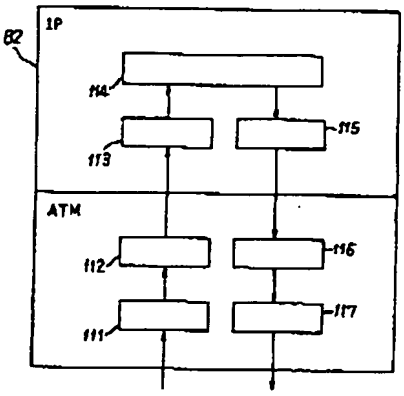
【図9】



【図7】



【図10】



【図8】